U. S. FOREST SERVICE

RESEARCH NOTE LS-64

LAKE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

A Test of Seeding Depth for Jack Pine and Red Pine

Direct seeding of jack pine (*Pinus banksiana* Lamb.) and red pine (*P. resinosa* Ait.) shows promise of being a successful regeneration technique in the Lake States (Roe 1963, Day 1964). Seedlings have been established on many small-scale trials when the seed was protected from birds and rodents and broadcast-sown on a prepared surface or spot-seeded on selected seedbeds. Direct seeding on larger areas, however, has not always been as successful—particularly with red pine.

Some of these variable results are undoubtedly caused by adverse environmental conditions, such as extreme fluctuations of temperature and moisture. Also, surface-sown seed is exposed to possible movement by wind and water. When the seed is covered with a thin layer of soil, it is better protected against the elements, and it has more moisture available for germination (Fraser and Farrar 1953, 1955). If the seed is planted too deep, however, severe losses will result (Stoeckeler and Jones 1957).

Optimum depth may vary under different growing conditions, but the critical depth (below which seedling establishment is sharply curtailed) is more consistent. A test of southern pines showed that optimum depth is slightly deeper in the field than in the greenhouse, but the critical depth is essentially the same in both places (Shipman 1963).

This study tested the effects of seeding depth on the germination and establishment of jack and red pine in a greenhouse. Groups of 50 seeds of each species were sown on one-square-foot seed flats (fig. 1) at depths of 0, 0.2, 0.4, 0.6, and 0.8 inch. The soil was a fine loamy sand. Each seeding depth was repeated four times in a completely randomized design. The seed was taken directly from cold storage (41° F.) and sown without pretreatment. Laboratory germination averaged 97 percent for jack pine and 87 percent for red pine.

The seed flats were maintained in the greenhouse for 50 days with temperatures ranging between 65° and 85° F. A photoperiod of 18 hours was provided by extending the natural daylength with artificial light. Surface-sown seeds, of course, were the only ones exposed to any substantial quantity of light during germination. Each seed flat received 0.5 inch of water on Mondays and Fridays to approximate the normal amount of precipitation in northern Minnesota during the growing season. Watering twice a week caused the soil surface to be alternately wet and dry, similar to conditions encountered in the field.

MAINTAINED AT ST. PAUL 1, MINNESOTA, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

F-511486

FIGURE 1. — One-square-foot seed flats were sown with 50 red pine (left 5 rows) and 50 jack pine (right 5 rows) seed. The seeds in this flat were covered with 0.2 inch of soil. This resulted in the highest number of established seedlings for red pine. Jack pine seedling establishment here was not significantly better than that from seed sown on the surface.

Counts were made periodically to record the progress of germination and mortality and the total number of seedlings established. Germination of the surface-sown jack pine seed started in 5 days, red pine in 11 days. The 0.2-inch sowing depth delayed the appearance of the first seedlings an average of 6 additional days for both species. The 0.4-inch sowing depth added still another 4 days. At the 0.6-inch depth very few seedlings became established, and they were delayed an additional 3 days—an average of 13 days after the germination of surface-sown seed. Only one seedling (red pine) was established from seed covered with 0.8 inch of soil, and it appeared 31 days after the first surface-sown seed had germinated.

Seedling mortality, recorded as a percent of the viable seed sown, was low for all treatments. It averaged 5.5 percent for both jack and red pine seedlings originating from surface-sown seed. It was less than 2.5 percent for seed covered with 0.2 and 0.4 inch of soil and none was recorded for either species at sowing depths of 0.6 or 0.8 inch (but few seeds germinated when planted at the latter two depths).

The observed mortality was caused by damping off, but this does not account for total seedling losses. At the end of the test it was found that some of the seedlings from covered seed died before emerging from the soil. It is possible that those from deeply sown seed simply ran out of energy before they could emerge.

The average tree percents 50 days after sowing are shown in figure 2. Trend lines connect the averages and their 95-percent confidence intervals between seeding depths. At seeding depths of 0, 0.6, and 0.8 inch, where the confidence bands overlap, there is no significant difference between species. But at depths of 0.2 and 0.4 inch the mean tree percent was significantly higher for red pine than for jack pine.

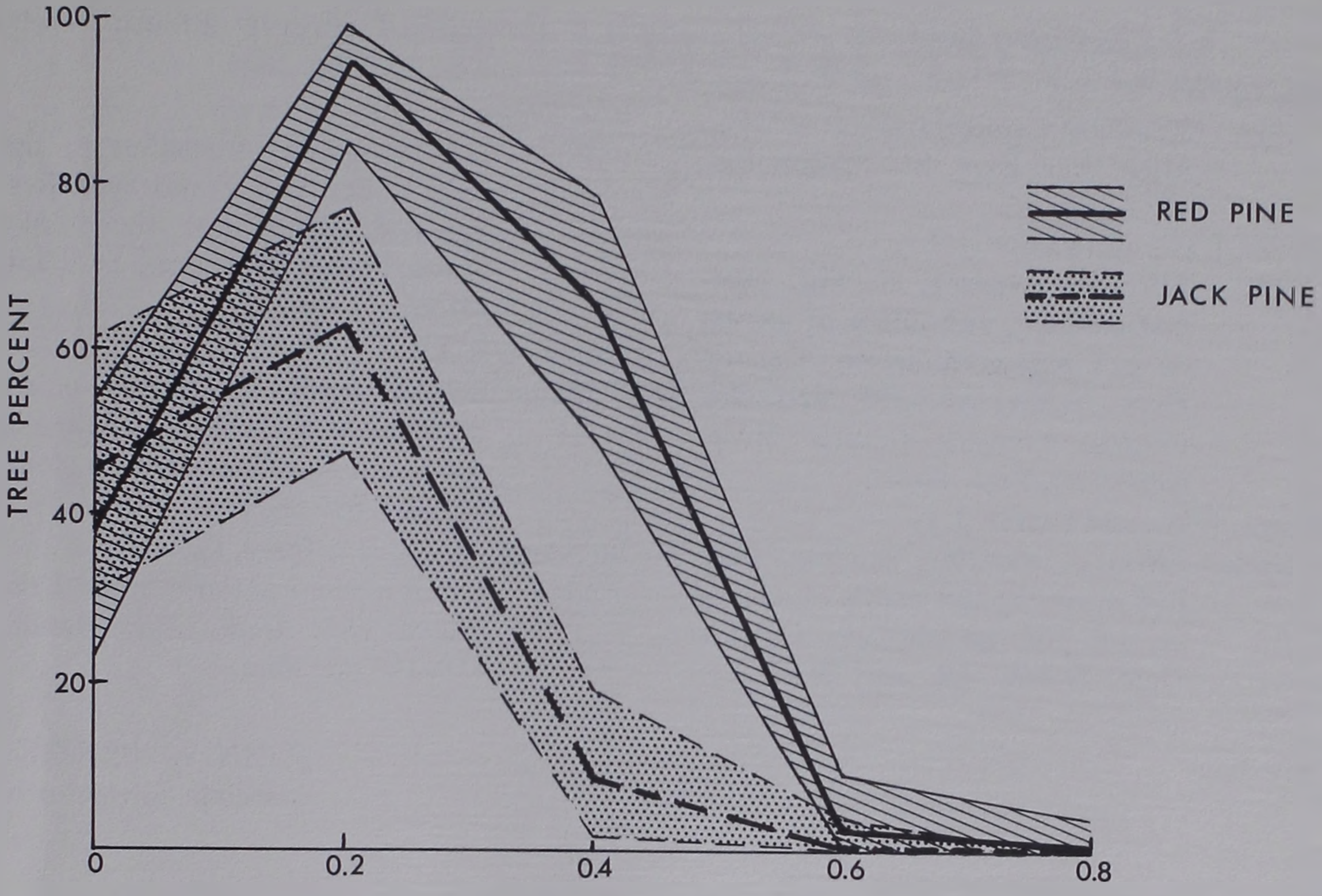

FIGURE 2.—Average tree percents and 95-percent confidence intervals for jack and red pine 50 days after sowing. Trend lines connect the means and their confidence limits between seeding depths. Depths where the confidence bands overlap indicate no significant difference.

Red pine tree percent increased from 38 when sown at the surface, to 94 when sown at a depth of 0.2 inch. The 0.4-inch depth resulted in an average tree percent of 65, not significantly higher than the 38 percent for surface-sown seed. Seeding depths of 0.6 and 0.8 inch failed, for all practical purposes.

Jack pine tree percent averaged 46 for surface-sown seed and 63 for a seeding depth of 0.2 inch, but the difference was not significant. A seeding depth of 0.4 inch proved to be very poor with an average tree percent of only 8. The 0.6- and 0.8-inch depths were essentially complete failures.

This study shows that critical seeding depth is between 0.4 and 0.6 inch for red pine and 0.2 and 0.4 inch for jack pine. Furthermore, it indicates that covering the seed may be very beneficial for red pine but is of questionable value for jack pine.

Literature Cited

Day, M. W.
1964. Results of a study on direct seeding. Mich. Agr. Expt. Sta. Quart. Bul. 46: 412-415.

Fraser, J. W., and Farrar, J. L.
1953. Effect of watering, shading, seedbed medium, and depth of sowing on jack pine germination. Canada Dept. North. Aff. and Natl. Resources. Forestry Branch Silvic. Leaflet 90, 4 pp., illus.

Fraser, J. W., and Farrar, J. L.
1955. Effect of watering, shading, seedbed medium, and depth of sowing on red pine germination. Canada Dept. North. Aff. and Natl. Resources. Forestry Branch Tech. Note 15, 3 pp., illus.

Roe, Eugene I.
1963. Direct seeding of conifers in the Lake States. U.S. Forest Serv. Res. Paper LS-3, 16 pp., illus. Lake States Forest Expt. Sta., St. Paul, Minn.

Shipman, R. D.
1963. Seeding depth—its influence on establishment of direct seeded pine in the South Carolina sandhills. Jour. Forestry 61: 907-912, illus.

Stoeckeler, J. H., and Jones, G. W.
1957. Forest nursery practice in the Lake States. U.S. Dept. Agr. Handb. 110, 124 pp., illus.

July 1965

JOHN W. BENZIE
Associate Silviculturist